Unmanned Aircraft Systems Integration in the National Airspace System (UAS-NAS)

Completed Technology Project (2017 - 2021)

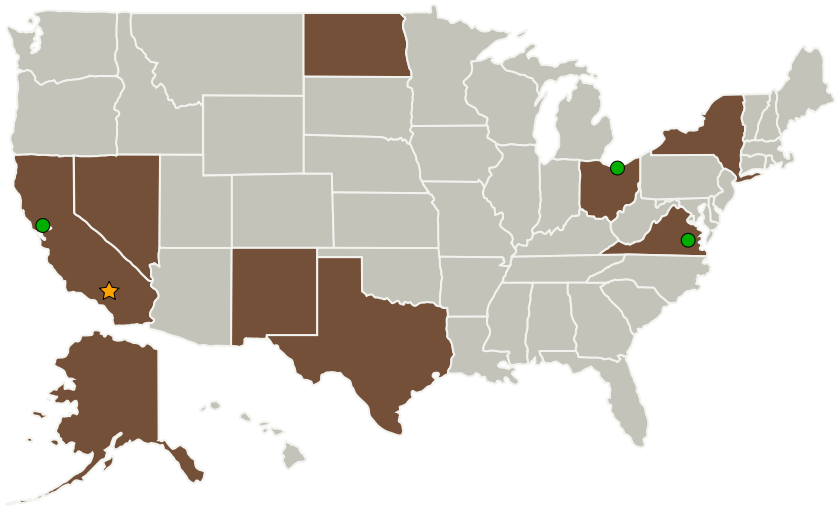
Project Introduction

The Unmanned Aircraft Systems Integration in the National Airspace System (UAS-NAS) Project supports the need of the UAS community to have routine access to the national airspace in order to conduct missions that are vital to a variety of national interests including enabling commercial applications. The goal of the Project is to provide research findings, utilizing simulation and flight tests, to support the development and validation of Minimum Operational Performance Standards necessary to integrate UAS into the National Airspace System.

Anticipated Benefits

NASA has determined that adequate Detect and Avoid (DAA) and Command and Control (C2) technologies are the most significant barriers to UAS integration. Verification and Validation data from DAA and C2 simulations and flight demonstrations will be provided to RTCA Special Committee – 228 to inform the development of DAA and C2 Minimum Operational Performance Standards (MOPS) that will be used by the Federal Aviation Administration (FAA) in future UAS rulemaking. DAA and C2 MOPS development will also serve to inform industry of the required DAA and C2 system performance needed for UAS certification.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
●Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Collins Aerospace	Supporting Organization	Industry	Cedar Rapids, Iowa
Federal Aviation Administration Alaska UAS Test Site	Supporting Organization	US Government	Alaska
Federal Aviation Administration Nevada UAS Test Site	Supporting Organization	US Government	Nevada
Federal Aviation Administration New Mexico UAS Test Site	Supporting Organization	US Government	New Mexico
Federal Aviation Administration New York UAS Test Site	Supporting Organization	US Government	New York
Federal Aviation Administration North Dakota UAS Test Site	Supporting Organization	US Government	North Dakota
Federal Aviation Administration Texas UAS Test Site	Supporting Organization	US Government	Texas

Continued on following page.

Organizational Responsibility

Responsible Mission Directorate:

Aeronautics Research Mission Directorate (ARMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Integrated Aviation Systems Program

Project Management

Program Director:

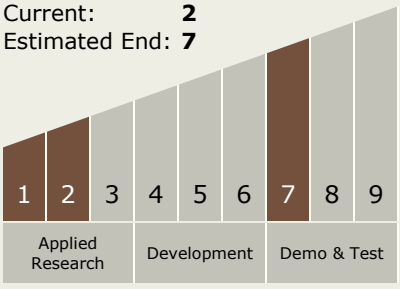
Richard L Noble

Project Manager:

Mauricio A Rivas

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **7**



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Organizations Performing Work	Role	Type	Location
Federal Aviation Administration Virginia UAS Test Site	Supporting Organization	US Government	Virginia
General Atomics	Supporting Organization	Industry	
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
Honeywell International	Supporting Organization	Industry	
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
Radio Technical Commission for Aeronautics	Supporting Organization	Industry	

Primary U.S. Work Locations	
Alaska	California
Nevada	New Mexico
New York	North Dakota
Ohio	Texas
Virginia	

Project Transitions

October 2017: Project Start

Technology Areas

Primary:

- TX16 Air Traffic Management and Range Tracking Systems
  - TX16.4 Architectures and Infrastructure

Target Destination

Earth

September 2021: Closed out

Closeout Summary: In 2009 various influential stakeholders within the Unmanned Aircraft Systems (UAS) community identified opportunities where NASA could be uniquely helpful. The FY2009 NASA Authorization Bill reflected the importance of UAS commercialization to Congress by calling for NASA to cooperate with other Government agencies, academia and industry in advancing UAS access to the National Airspace System (NAS). NASA's historical interactions with other Government agencies provided the needed framework for collaboration and coordination between NASA, the FAA (in particular), and other stakeholders in the formulation of the UAS Integration in the NAS (UAS-NAS) Project. The initial formulation work led to a deliberate focus of working towards routine access of UAS in the NAS for civil and commercial purposes. This focus helped determine the technical areas where NASA had the means and resources to assist the community. These areas were Separation Assurance and/or Collision Avoidance, which UAS-NAS addressed via the Detect and Avoid (DAA) Technical Challenge (TC); Pilot Aircraft Interface, which UAS-NAS addressed via the Human Systems Integration (HSI) team; Certification Requirements, which UAS-NAS addressed initially as a proposed activity, and eventually with the Systems Integration and Operationalization (SIO) activity; and Communications, which UAS-NAS addressed with Command and Control (C2) TC. At the start of the project, it was recognized that research was needed to support the development of requirements and standards for DAA systems. It was acknowledged that these were necessary systems to safely integrate UAS into the NAS in compliance with FAR Part 91.113. The means were missing for electronically avoiding collisions. Also missing, was a definition of what "well clear" really meant for a UAS. The UAS-NAS Project provided answers to these questions. Effectively providing the bulk of the simulation and flight test data and analyses that resulted in DAA and Air-to-Air Radar (ATAR) Minimum Operational Performance Standards (MOPS). Later, the project leveraged these DAA and ATAR MOPS, and their corresponding FAA Technical Standard Orders (TSO), to demonstrate the safe compliance with 91.113 while accomplishing the No-Chase Certificate of Airworthiness Waiver (COA) or NCC demonstration. Similarly for C2, when the project started there were no requirements or standards in place for spectrum to support UAS communications (command and control included). NASA's research directly led to the development of MOPS for Terrestrial C2, as well as FAA TSO (C-213). The Control Non-Payload Communication (CNPC) radio Version 7 developed by Collins (with help from NASA) is considered the radio that most closely meets the C2 MOPS, and the project performed testing of that radio to further update the C2 Terrestrial MOPS. With regards to the Operational Test Environment, recognizing that new technologies need to be tested in a relevant environment that is representative of the NAS, the project developed the means to enable the safe performance of such tests. Testing in a relevant environment helps build confidence and acceptance by FAA regulators and the general public. The Live Virtual Constructive Distributed Environment (LVC-DE) was particularly useful, especially as its results were validated with flight test data. When the project began, the FAA's business structure was not yet organized to address the integration or accommodation UAS in the NAS in a coordinated manner across their different lines of business. Close collaboration between the two agencies helped advance the FAA's structural organization to better support the growing UAS market. The NASA/FAA UAS Integration Research Transition Team (RTT) particularly proved to be an excellent forum for focusing both NASA's and the FAA's work; while keeping executives at both Agencies aware of progress and challenges. A most telling indicator of the project's success was its impact in industry. When the project began, industry needed a more reliable and repeatable methodology for sustained UAS integration efforts. Standards, policies, procedures, and regulations for integrating UAS in the NAS were missing, especially to address the incorporation of the unique aspects of UAS. As a result of the UAS-NAS Project, critical MOPS and TSOs were developed and made available for industry, to the point that one of the project's SIO partners, leveraged NASA's work, and obtained a No Chase COA approval — a first for private use of a UAS that size. In summary, the UAS-NAS Project was fully successful at advancing the state of the art — at enabling UAS commercialization through the development of standards based on research findings validated in a relevant environment. Additionally, the UAS-NAS Project was a catalyst for increased FAA involvement, and helped advance the opportunities for industry to commercialize UAS operations at all altitude regimes.

Closeout Link: https://ntrs.nasa.gov/citations/20205008800

Links

Flight Test 6 (FT6)
(https://www.nasa.gov/centers/armstrong/features/making-skies-safe-for-unmanned-aircraft.html)

Systems Integration and Operationalization (SIO): American Aerospact Technology Incorporated (AATI)
(https://www.nasa.gov/centers/armstrong/features/gas-pipeline-inspections-simulated.html)

Systems Integration and Operationalization (SIO): Bell
(https://www.nasa.gov/centers/armstrong/features/second-sio-demo-flight.html)

UAS highlight trailer
(https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fyoutu.be%2FlKqI8Yyc8_A&data=04%7C01%7Csherilyn.a.brown%40nasa.)

UAS-NAS 45 sec promo
(https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fyoutu.be%2F0Vt63ZTwHhc&data=04%7C01%7Csherilyn.a.brown%40nasa.)

UAS-NAS video “Setting the Standards for Unmanned Aircraft”
(https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fyoutu.be%2Fd__qPVnycnc&data=04%7C01%7Csherilyn.a.brown%40nasa.)

Project Website:

https://www.nasa.gov/aeroresearch/programs/iasp/uas